

Glendon® BioFilters

Recommended Standards and Guidance for Performance, Application, Design and Operation & Maintenance



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TABLE OF CONTENTS

PREFACE	3
ACKNOWLEDGEMENTS.....	4
TERMS AND ABBREVIATIONS	4
CHANGES IN RS&G FOR GLENDON® BIOFILTER FROM INTERIM RS&G (DATED 1996)	5
INTRODUCTION	6
PERFORMANCE STANDARDS	8
LISTING	8
PERFORMANCE TESTING	9
PRODUCT PERFORMANCE.....	9
APPLICATION STANDARDS.....	9
LISTED PRODUCTS.....	9
PERMITTING	9
INFLUENT CHARACTERISTICS.....	10
SITE REQUIREMENTS	10
DATA PLATE	12
DESIGN STANDARDS	12
PRETREATMENT.....	12
DAILY DESIGN FLOW.....	12
TREATMENT CAPACITY	12
WASTEWATER FLOW PATTERNS.....	13
CONTAINMENT VESSEL REQUIREMENTS	13
ABSORPTION AREA REQUIREMENTS	14
LOCATION AND ORIENTATION	16
PROTECTED DESIGN ELEMENTS.....	17
MONITORING PORTS	17
PLAN REVIEW AND APPROVAL	18
SITE PREPARATION / PROTECTION DURING CONSTRUCTION	18
INSPECTION	18
OPERATION AND MAINTENANCE	18
LIMITED WARRANTY	19
OWNER’S MANUAL	19
APPENDIX A – SITE PREPARATION AND PROTECTION DURING CONSTRUCTION	21
APPENDIX B – GLENDON DATA PLATE.....	22
APPENDIX C – GLOSSARY OF TERMS	23

Preface

The recommended standards contained in this document have been developed for statewide application. Regional differences may, however, result in application of this technology in a manner different than it is presented here. In some localities, greater allowances than those described here may reasonably be granted. In other localities, allowances that are provided for in this document may be restricted. In either setting, the local health officer has full authority in the application of this technology, consistent with Chapter 246-272 WAC and local jurisdictional rules. If any provision of these recommended standards is inconsistent with local jurisdictional rules, regulations, ordinances, policies, procedures, or practices, the local standards take precedence. Application of the recommended standards presented here is at the full discretion of the local health officer.

Local jurisdictional application of these recommended standards may be:

- 1) **Adopted as part of local rules, regulations or ordinances**—When the recommended standards, either as they are written or modified to more accurately reflect local conditions, are adopted as part of the local rules, local rule authority governs their application.
- 2) **Referred to as technical guidance in the application of the technology**—The recommended standards, either as they are written or modified to more accurately reflect local conditions, may be used locally as technical guidance.

Application of these recommended standards may occur in a manner that combines these two approaches. How these recommended standards are applied at the local jurisdictional level remains at the discretion of the local health officer and the local board of health.

The recommended standards presented here are provided in typical rule language to assist those local jurisdictions where adoption into local rules is the preferred option. Other information and guidance is presented in text boxes with a modified font style to easily distinguish it from the recommended standards.

[Back to Table of Contents](#)

Acknowledgements—

The Department of Health's Wastewater Management Program appreciates the contribution of many persons in the on-going development, review, and up dating of the Recommended Standards and Guidance documents. The quality of this effort is much improved by the dedication, energy, and input from these persons, including:

- ❑ Geoflow, Inc.
- ❑ Glendon® BioFilter Technologies
- ❑ Lombardi and Associates
- ❑ Orenco Systems, Inc.
- ❑ Puget Sound Water Quality Action Team
- ❑ Sun-Mar Corporation
- ❑ Washington State On-Site Sewage Association (WOSSA)
- ❑ Washington State On-Site Sewage Treatment Technical Review Committee (TRC)
- ❑ Waste Water Technologies

Terms and Abbreviations Used in This Document—

- ❑ BOD₅ – Biochemical Oxygen Demand (see Glossary)
- ❑ DOH – Washington State Department of Health
- ❑ GPD – Gallons per day
- ❑ WAC – Washington Administrative Code (see Glossary)
- ❑ WAC 246-272 – On-Site Sewage Systems-Rules and Regulations of the State Board of Health

[Back to Table of Contents](#)

Changes in RS&G for Glendon® BioFilter from Interim RS&G (dated 1996)

- Appearance and format match all other RS&Gs
- Illustrations and guidance boxes added
- Trade secret information is released (under separate cover) to Local Health Jurisdictions to allow effective design review and installation inspection. *[This feature should reduce concerns about quality control for this technology.]*
- Maximum daily design flow per system increased to 3500 GPD.
- Requirement for proportional flow when using multiple units.
- Requirement for initial and replacement absorption areas to be available and sized according to WAC 246-272. Initial installation may be up to 50% of this absorption area.
- Setbacks
 - From the edge of the full sized absorption area.
 - Apply to the reserve area
 - In addition to property and easement lines, setbacks also apply to building foundations, mounds, other Glendon units or any other object that impedes the flow of subsurface water.
 - Setback distances related to soil depth and are consistent with what is allowed for other technologies that are used with limited soil depth.
- Glendon® BioFilter Data Plate is required on all control panels
- Minimum size septic tank is 1000 gallons
- Annular space between the vessel and the undisturbed native soil (created when over excavating for the vessel) must be subtracted from the absorption area calculations.
- Location and orientation requirements and limitations
- Site protection requirements, including an approved construction plan that details the sequence of events.
- O&M Section
 - Expanded
 - Requirement for warranty period
 - Requirement for owner's manual
- Requirement that basin be approved by P.E. for ability to maintain level rim and water tightness. Evaluation to include material specifications, fasteners and construction methods.

[Back to Table of Contents](#)

Introduction—

Glendon® BioFilter Technologies and their affiliates currently market, design, construct, install, and service two models of residential wastewater treatment units. Both units are upflow media filters and are based upon the same patented principles, which involve the biological treatment of septic tank effluent as it flows upward through sequential layers of mineral filter media within an in-ground containment vessel and then out of the vessel through matric and gravitational forces. No separate drainfield is required as final treatment and effluent disposal occurs in the native soil surrounding the vessel. The effluent from the vessel is conveyed from the vessel to the prepared native soil through the cover sand material. This cover sand is the top layer of sand, which continues over the rim and out over the native soil at the perimeter of the containment vessel.

The two Glendon® BioFilter models share the same wastewater treatment components, incorporating pre-treatment (septic tank), dosed distribution (pump chamber, controls & mechanics), biological treatment (BioFilter), and treated wastewater disposal (perimeter absorption area). Many of these components exist with other treatment systems. Glendon® BioFilters are uniquely characterized by the shape, size, volume and setting of its containment vessel or basin, the treatment media inside, the dispersal / disposal medium surrounding the unit, and the hydraulic dosing pattern to the filter.

Figure 1

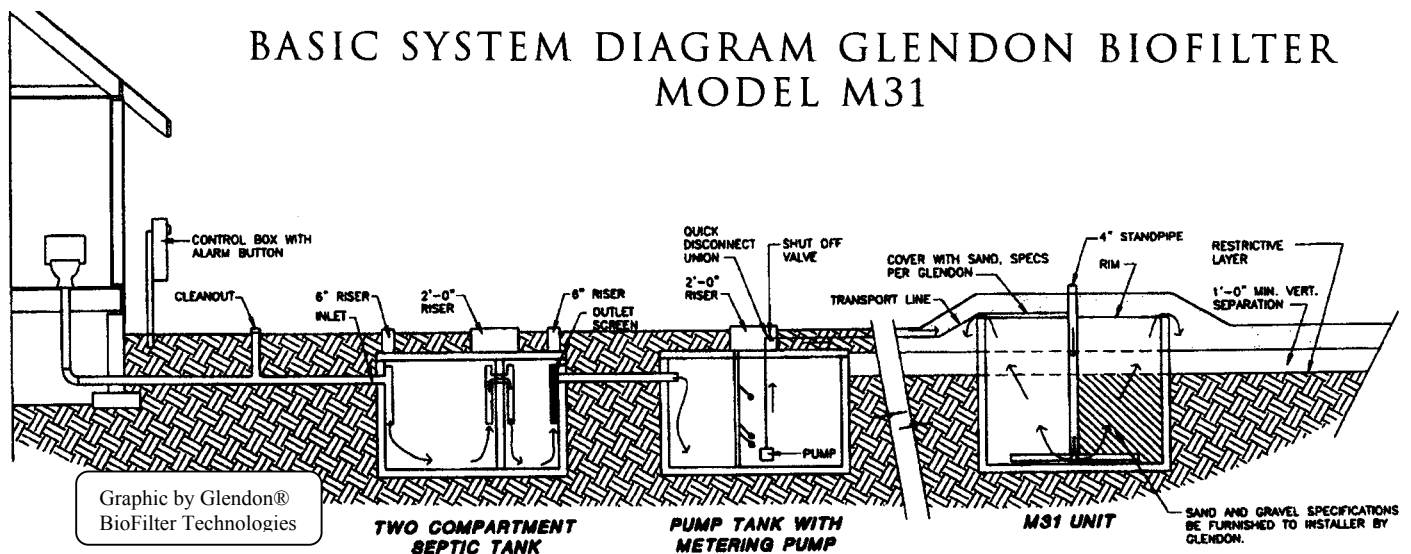


Figure 2 – Top View, Sloped and Unsloped Sites

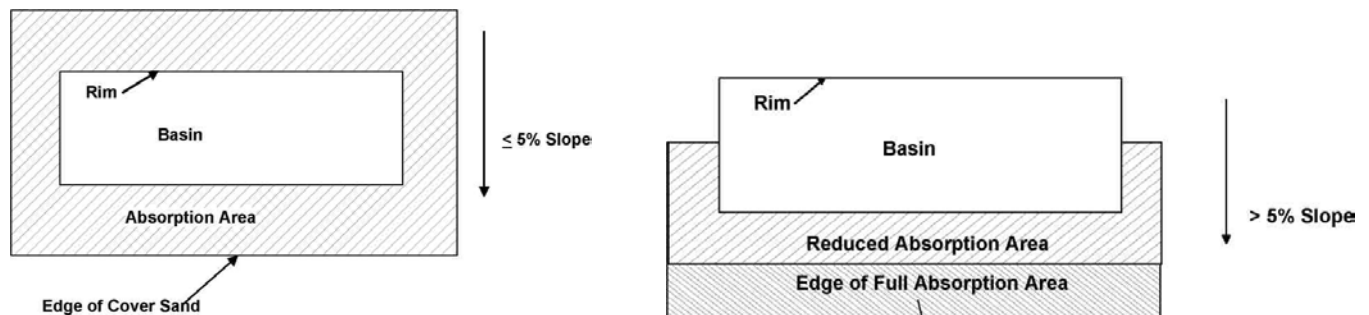


Figure 3

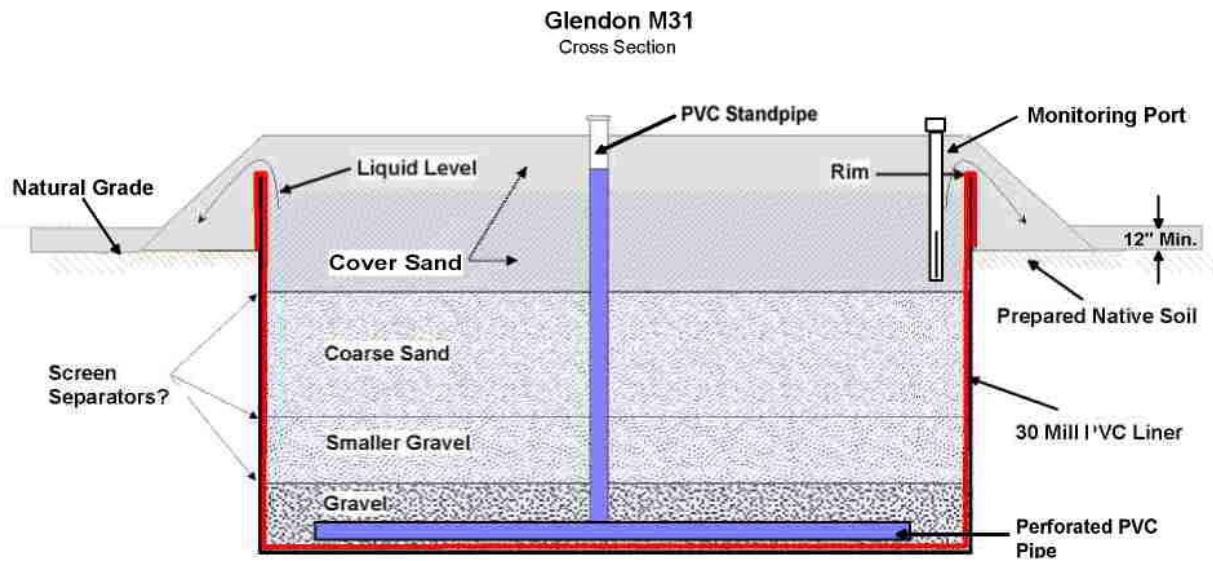
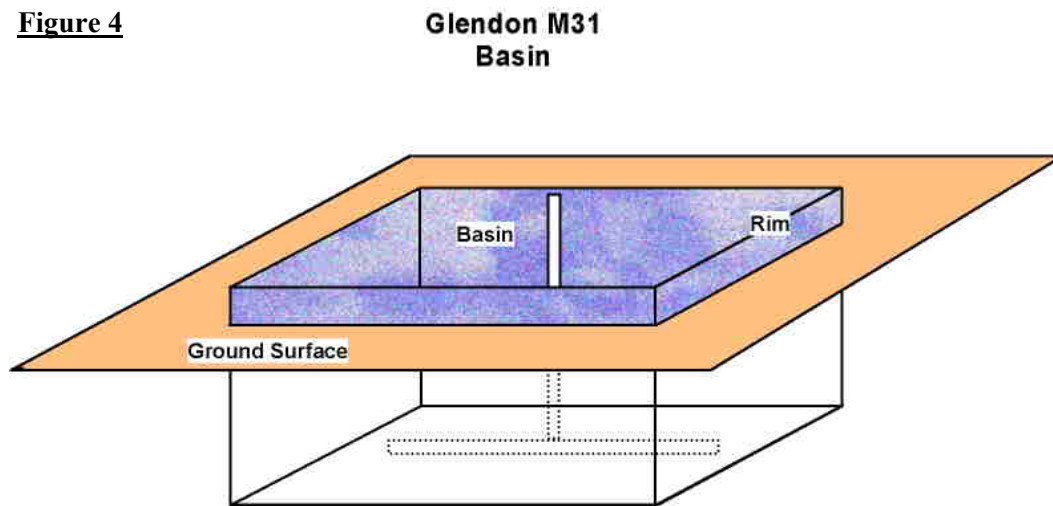


Figure 4



Example 1 – Glendon M31



Example 2 – Glendon M31



Example 3 – Glendon M31



1. Performance Standards—

1.1. Listing—

- 1.1.1.** Before a local health jurisdiction may issue a permit for an on-site wastewater system incorporating a Glendon® BioFilter, the model must be included on the current DOH List of Approved Systems and Products (WAC 246-272-04001(2)).
- 1.1.2.** DOH reviews and lists proprietary products based upon the manufacturer-provided detailed information demonstrating that individual Glendon® BioFilter models meet or exceed the performance testing requirements defined in 1.2 of this document.

1.1.3. Models and Capacities — The following models are listed in the DOH List of Approved Systems and Products.

1.1.3.1. Glendon® BioFilter Model M3 is a large, entirely site-constructed unit, with design flow capacities from 240 GPD to 480 GPD.

1.1.3.2. Glendon® BioFilter Model M31 is generally smaller than the Model M3, and exhibits a different geometry and has a different ratio of basin volume to GPD. Model M31 has design flow capacities from 90 GPD to 500 GPD. Units may be partially prefabricated off-site or entirely site-constructed.

1.1.3.3. Multiple units, in the same or a variety of sizes, may be used in parallel to accomplish daily design flows to 3500 GPD. Additional requirements for systems between 1000 and 3500 GPD are listed in WAC 246-272-11501(2)(J). (See **3.3.** and **3.4.**)

1.2. Performance Testing— The Glendon® BioFilter models listed in the DOH List of Approved Systems and Products were tested according to a protocol based on and modified from the NSF Standard 40 protocol.

1.3. Product Performance—

1.3.1. Models M3 and M31 of the Glendon® BioFilter met all three parameters of Treatment Standard 1, without disinfection, in the treatment of residential strength wastewater.

1.3.2. Performance with high strength wastewater has not been tested.

2. Application Standards—

2.1. Listed Products—Only wastewater treatment and disposal products listed in the current edition of the DOH List of Approved Systems and Products may be permitted by local health jurisdictions for systems within their jurisdiction [WAC 246-272-04001(2)]. Only the specific models listed in the document are approved. If other models in a manufacturer's product-line do not appear on the list, they are not approved for use in Washington State. If in doubt, contact DOH for current listing information.

The most recent version of the DOH List of Approved Systems and Products can be obtained by downloading it from the following web site or by calling 360-236-3062. www.doh.wa.gov/wastewater.htm

2.2. Permitting—

2.2.1. Installation permits, and if required, operational permits must be obtained from the local health officer prior to installation and use.

2.2.2. Any application of Glendon® BioFilters outside of the conditions, allowances or criteria described in subsection 2.0 **Application Standards** may require a waiver of local health jurisdiction rules.

2.2.3. Because of the proprietary nature of some elements of the installed product, Glendon® BioFilter must only be constructed by installers licensed and certified by Glendon®

BioFilter Technologies. Operation and maintenance activities outside the scope of the system owner must also be accomplished by service providers licensed and certified by the manufacturer.

- 2.2.3.1.** For local health jurisdictions that require designers of Glendon systems to certify that the designs meet all the specifications of the tested and approved units, designers may also need to have knowledge of all components, including the elements protected by trade secret.

The Glendon company asserts that the installers and operation and maintenance specialists licensed by their company have received training in all aspects and features of installing Glendon® BioFilter, including the elements that are held as trade secrets. Local health jurisdictions may require the Glendon company to specify the type and number of hours of training given to the licensed installers, what continuing education is required and what type of follow-up supervision is being done to assure that the installations meet all the design elements of the tested models.

- 2.2.4.** For sites where either Treatment Standard 1 or 2 must be met, some means acceptable to the local health jurisdiction must be implemented to assure proper on-going operation and maintenance (O&M) of the Glendon® BioFilter and the remaining system components as long as the facility is served by the on-site sewage system. The following options may be used separately or in combination, to assure long-term O&M of Glendon® BioFilter systems:

- 2.2.4.1.** recording the requirement for an on-going service contract on the property deed;
- 2.2.4.2.** issuing an operating permit (in addition to the initial installation permit), with the requirement for maintaining a service contract; or,
- 2.2.4.3.** requiring a management entity to provide O&M assurance. Examples of management entities include: cities & towns, public utility districts, water & sewer districts, special-use districts, and corporations and home-owner associations with demonstrated capacity to assure long-term management.

- 2.2.5.** Local health jurisdictions may implement O&M assurance measures (see 2.2.4) for sites other than those where Treatment Standard 1 or 2 is required to be met.

- 2.3. Influent Characteristics—** Models M3 and M31 were tested and approved for the treatment of residential wastewater. Therefore Glendon® BioFilters may only be used for influent that is typical of residential wastewater.

This technology may be used for facilities generating effluent that is higher strength or in some other way not typical of residential domestic wastewater if appropriate pretreatment is used to bring the wastewater flowing into the Glendon system within the range of parameters describing residential domestic quality wastewater.

- 2.4. Site Requirements—** For new construction where the installation and use of a Glendon® BioFilter is proposed, sites must exhibit the following conditions:

- 2.4.1.** Soil Types 1A, 1B, 2A, 2B, 3-6 as classified in WAC 246-272-11001.
- 2.4.2.** A minimum of 12 inches of undisturbed, native soil. This 12 inches of soil must be reflected in the site-specific design, maintained by installation, and be free from the following conditions:
 - The maximum seasonal high groundwater level;

[Back to Table of Contents](#)

- A layer of creviced or porous bedrock; or
- A stratum of impermeable soil or bedrock (including very slowly permeable soil).

2.4.3. Maximum ground surface slope of 20%.

Glendon® BioFilter Technologies has asked for removal of this restriction to 20% slopes. The reason for this restriction for Glendon® BioFilter and mounds is the need for stability of the imported sand materials. There may also be some concerns for operating the equipment without damage to the downslope receiving soils. When a design for a Glendon is proposed for slopes greater than 20%, it is the position of DOH that the designer must provide adequate documentation that proposed mitigation of the concerns will be realized.

2.4.4. Horizontal setbacks –

- 2.4.4.1.** Are measured from the edge of the full absorption area (Figure 5) or from the edge of the full replacement absorption area if the replacement area is a concentric area around the initial area.
- 2.4.4.2.** Are specified in WAC 246-272-09501, with the exception of certain downslope features as noted in the Table 1 below:

Table 1. Minimum Setbacks From Downslope Feature

Downslope Feature or Object	Vertical Separation (See 2.4.1 and 2.4.2)		
	12'' - <18''	18'' - <30''	30+''
Property & Easement lines	30 Feet	5 Feet	5 Feet
Building Foundations	30 Feet	10 Feet	10 Feet
Mounds	30 Feet	10 Feet	10 Feet
Glendon Basins	30 Feet ¹	10 Feet	10 Feet
Interceptor/Curtain Drains/Drainage Ditches	30 Feet	30 Feet	30 Feet
Other objects that impede the movement of water through the soil	30 Feet	10 Feet	10 Feet

¹ As measured from the downslope edge of the full absorption area (and the full replacement area, if the replacement area is concentric with the initial area) of the upper unit to the upslope wall of the lower basin.

The setback distances for soil depth of 18 inches to less than 30 inches are what are allowed for a pressure distribution drainfield following a TS1 or TS2 treatment system with this depth of soil.

The setback distances for 30+ inches of soil are what are allowed for pressure distribution drainfields with this depth of soil.

Glendon® BioFilter Technologies has also asked that the restrictions in Table 1 be removed. The DOH position is that shallow soils offer a limited conduit for water to leave the site of application. Therefore, the shallower the soils, the greater the need to protect the downstream soil profile for conducting water away from the site. Therefore, DOH chooses to leave these restrictions in place.

- 2.4.5. Extreme Cold Weather Climates Excluded –** Application of Glendon® BioFilter Models M3 and M31 is limited to areas with climates exhibiting an annual accumulation of 6000 degree heating days or less. Glendon® BioFilter Technologies must furnish local health jurisdictions the reference material needed to determine these areas in Washington

State. Alternatively, local health officers may require designers to show that the proposed system is not in a cold weather prohibited area.

Heating Degree Days - Heating engineers who wanted a way to relate each day's temperatures to the demand for fuel to heat buildings developed the concept of heating degree days.

To calculate the heating degree days for a particular day, find the day's average temperature by adding the day's high and low temperatures and dividing by two. If the number is above 65, there are no heating degrees for that day. If the number is less than 65, subtract it from 65 to find the number of heating degrees for the day. Annual degree heating days is the sum of all the individual heating degrees for the year.

For example, if the day's high temperature is 60 and the low is 40, the average temperature is 50 degrees. 65 minus 50 is 15 heating degree days.

2.5. Data Plate

2.5.1. The Glendon system must have a permanent and legible Glendon® BioFilter data plate (as shown in Appendix B) located on the front of the electrical control panel box. These plates may be in the form of a permanent sticker, decal or embossed plate.

2.5.2. Each data plate must include:

2.5.2.1 service provider's name and phone number,

2.5.2.2 model number, and

2.5.2.3 rated daily hydraulic capacity

The data plate on the electrical control panel box will verify that a licensed and certified Glendon installer accomplished the installation.

3. Design Standards—

3.1. Pretreatment – External pre-treatment for solids separation and settling must be provided by a conventional two-compartment septic tank, sized according to state (WAC 246-272-11501(2)(d)(A) and local rules, except that the minimum size is 1000 gallons. When a pump vault is used in a single-compartment septic tank for combined septic tank and dosing functions, refer to the appropriate sections of the DOH publication: *Recommended Standards and Guidance for Pressure Distribution*.

Washington State DOH is currently developing standards for septic tanks. When this document is approved and available, all septic tanks will need to meet the minimum requirements therein.

3.2. Daily Design Flow – Design flow calculations / specifications must be consistent with state (WAC 246-272-11501(2)(c)) and local rules.

3.3. Treatment Capacity – Site-specific treatment system capacity may be met with any combination of Glendon® BioFilter models and sizes. Units of various sizes (GPD capacity) may be combined in parallel flow to meet daily design flow up to 3500 GPD (See 3.4. and note in 1.1.3.3.).

3.3.1. Model M3: 240 – 480 GPD per individual unit

3.3.2. Model M31 90 – 500 GPD per individual unit

3.4. Wastewater Flow Patterns – Wastewater flows from a conventional 2-compartment septic tank, through a pump chamber / surge tank, to one or more Glendon® BioFilters. Wastewater must be distributed to all units throughout each site-specific system in a parallel pattern such that each unit receives a proportional share, based on the GPD capacity of each unit. Pumping cycles / timing must be set to assure that the design capacity of each unit is not exceeded in any 24 hour period. The specifics of the pump cycles / patterns have been identified by Glendon® BioFilter Technologies as subject to statutory trade secret protection. This information is available to local health jurisdictions in a letter to them from DOH. Local health jurisdictions are subject to restrictions relative to proprietary information. See Section 3.9.

3.5. Containment Vessel Requirements – Various design element requirements for containment vessels (basins) are presented in Table 2.

Table 2. Containment Vessel
(Also see 3.5.1.)

Design Element	Glendon® BioFilter Models	
	M3	M31
Basin (containment vessel)		
Volume w/o media	6.0 ft ³ per GPD capacity of individual unit.	2.2 ft ³ . per GPD capacity of individual unit.
Shape ^{1,2}	Depth: 10-10.5 feet Width: 15-20 feet Length: 15-40 feet	Depth: 5-5.5 feet Width: 4-6 feet Length: 4-60 feet
Perimeter rim length	1 lineal foot per each 4 GPD capacity of individual unit	
Perimeter rim grade	Level, ± ½ inch	
Shape established by:	Excavation	Excavation, manufactured tank, or built-on-site basin.
Basin sides:	Sloped 45-50 degrees	Vertical; may be sloped to 50 degrees
Basin bottom:	“V” shaped or flat	Flat
Perimeter rim:	Grade established by posts and boards, liner supported by earthen berm under rim, liner placed over boards and berm.	Grade established by posts, board and sheet-goods frame (also supplies basic shape to geomembrane-lined basin). Manufactured tank may also be used: rim established by top perimeter edge.
Backfill requirements:	N/A	For geomembrane-lined basins, the internal filter media, and the backfill material must be placed at the same time in an alternating sequence to equalize pressures on the frame and membrane. A similar approach may be necessary for manufactured containers, depending upon the materials used in manufacture.
Liner	Required for in-ground construction with lumber and 30 mil PVC geomembrane. Must be protected from puncture and abrasion during construction. May also be necessary for prefabricated concrete vessels in order to assure water tightness.	
Materials	Impervious liner of 30 mil PVC (or equivalent), or pre-cast concrete tank, site-inspected to assure water-tightness. All lumber used in the containment vessel frame must be pressure treated.	
¹ Basin configurations outside the above parameters should be subject to agreement with the Washington State Department of Health.		
² The specific shape of a Glendon® BioFilter is governed by the design flow capacity (see subsection 3.3), the volume and the perimeter rim length criteria noted in this table.		

3.5.1. Containment vessel design and construction standards – A professional engineer licensed in the state of Washington must stamp all containment vessel designs. Containment vessels that have been reviewed and approved by DOH for Glendon® BioFilter applications may also be used and incorporated by reference in the design. The evaluation must include:

- 3.5.1.1.** A review and listing of the material specifications, fasteners and construction methods to be used,
- 3.5.1.2.** A conclusion that the vessel will maintain its watertightness and rim elevations over the life of the system, and
- 3.5.1.3.** A description of how the rim would be reconstructed, if decay of the lumber caused it to be out of tolerance, while maintaining the water tightness of the vessel.

3.5.2. Watertightness— To achieve treatment to the levels in the tested units, the containment vessels (basins) of the Glendon® BioFilter must be constructed and remain watertight during its entire service life. Liners may also be necessary for prefabricated vessels to assure watertightness.

3.5.3. Annular space outboard of the containment vessel— In order to place a prefabricated vessel or to construct a vessel on site, the excavation includes an annular space between the outside of the Glendon vessel and the sides of the excavation. The following criteria must apply to the annular space:

- 3.5.3.1.** Must not be larger than 6 inches on each side of the vessel.
- 3.5.3.2.** Must not be calculated as part of the absorption area
- 3.5.3.3.** Must be backfilled with soil material of Type 2B-6 (May be spoils from excavating the hole for the basin, if from Type 2B-6).
- 3.5.3.4.** Must be backfilled at the same time as the internal materials are placed, in an alternating sequence to equalize pressures on the vessel walls if the containment vessel is susceptible to deflection and damage under uneven loading.

3.6. Absorption Area Requirements – The absorption area required is based on the soil type and the daily design flow. Daily design flow and application rates for the various soil types are specified in WAC 246-272-11501(2)(c)(i) and WAC 246-272 Table V, respectively. Additional requirements are in Table 3 of this document. See Figure 5.

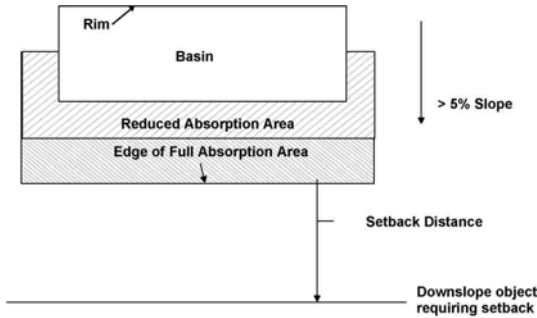
3.6.1. Absorption Area – The absorption area begins outside of the basin at the edge of the undisturbed native grade (i.e. the over-excavation for the vessel is not to be counted as absorption area) and extends to the outer edge of the BioFilter cover sand.

3.6.2. Reductions –The local health officer may approve the installation of smaller absorption areas according to the Recommended Standards and Guidance for Effluent Quality-Based Drainfields as long as the remainder of the required area is available and protected from damage and other development.

3.6.3. Reserve Area – Reserve area must also be sized and located according to the criteria stated in 3.6. and in Table 3. Also see Figure 5.

Figure 5 —

**Absorption Area and Setback for Slopes > 5%
 Separate Reserve Area (Not Shown)**



**Absorption Area and Setback for Slopes > 5%
 Concentric (Donut) Reserve Area**

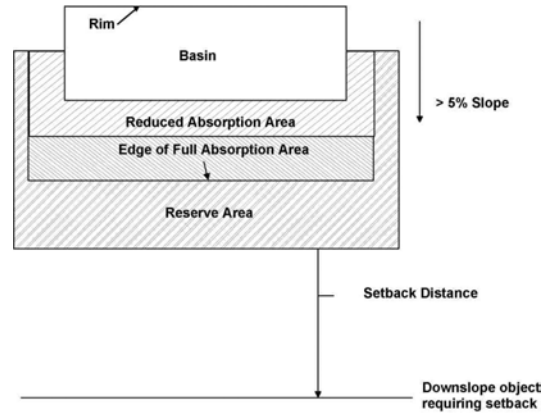


Table 3. Absorption Area

Design Element	Glendon® BioFilter Models M3 and M31
Effluent-to-Soil Absorption	
Maximum Hydraulic Loading Rates	As specified per WAC 246-272, Table V. Minimum installed absorption area may be 50% of required available area, as per Recommended Standards and Guidance for Effluent Quality-Based Drainfields, Table 1, Column A. (See Guidance box below.)
Absorption Area & Location	Ground Slope: <ul style="list-style-type: none"> • ≤5%: Entire perimeter may be used for sizing adjacent absorption area¹. • >5%: Only downslope side, and ½ of end slope sides may be used for sizing adjacent absorption area¹.
Replacement Area	The replacement area may be: <ol style="list-style-type: none"> 1) an entirely separate, reserved location providing adequate area and soil conditions for a complete system replacement or 2) reserved area surrounding each unit (if site has 5% slope or less) or downslope from each unit (if site has more than 5% slope), for placement of additional cover sand media to provide a full-sized replacement basal area beyond the area necessary for a full-sized initial area. (See Guidance box below).
¹ See 3.6.1.	

The previous version of the Recommended Standards and Guidance for Glendon® BioFilter allowed for a 50% reduction in required absorption area for both the initial and replacement areas, without any required area set aside for full sized absorption areas. This version requires sufficient suitable area on the property to construct full sized absorption areas (primary and reserve) and thus brings the Glendon® BioFilter Technology into compliance with the Recommended Standards and Guidance for Effluent Quality-Based Drainfields, to which all other on-site technologies are now held accountable. Any deviation from this standard should be well justified and be accompanied by adequate mitigation.

3.7. Media Specifications—Depth of the cover sand, specifications for the other media, their depth and arrangement within the Glendon® BioFilter are parts of the system that have been identified by Glendon® BioFilter Technologies as subject to trade secret protections. See Section 3.9. for details.

3.7.1. Cover Sand—

- 3.7.1.1. Must be within the specifications contained in the trade secret materials released to the local health jurisdictions (See 3.9.).

Sands in the specified range are acceptable for meeting Treatment Standard 1 and 2. Until performance testing of sands having other specifications are submitted, reviewed, and approved, the only sands acceptable for meeting Treatment Standard 1 and 2 are those within the range specified in 3.7.1.

- 3.7.1.2. Must be stabilized from sloughing from animal and foot traffic, erosion and other forces.

Jute netting or cyclone fencing laid over the cover sand after seeding are two methods currently prescribed by Glendon® BioFilter Technologies. Other strategies may be possible, but some effective way to maintain the integrity and stability of the steep sand slopes must be employed.

- 3.7.1.3. Have a minimum of 12 inches of unsettled cover sand over the absorption area.

- 3.7.2. **Other Media** – The depth of the cover sand and the specifications and depth of the other media are available to Local Health Jurisdictions (See 3.9.)

3.8. Location and Orientation –

- 3.8.1. The long axis of each BioFilter unit must be oriented along the contour of the native soil, and multiple units must also be aligned along the same contour line, where possible. When not located on the same contour, multiple units must not be placed along the same line of groundwater flow without meeting the horizontal separations specified in Section 2.4.4. of this document.

The design goal for all on-site sewage systems is to maintain subsurface flow of wastewater discharged to the soil. The concept of Linear Loading Rate (LLR) has been developed in the scientific literature.^{1, 2} LLR is defined as the loading rate of wastewater per linear foot of infiltrative system in the native soil (gallons per day per linear foot) along the contour. The LLR can be greater for deep, permeable soils and will be less for shallow soils over a restrictive layer or shallow water table. One rule of thumb is: if the flow away from the soil absorption system is primarily vertical, then the LLR can approach 10 gpd/lineal foot; if the flow away from the soil absorption system is primarily horizontal, then the LLR should be constrained to 3-4 gpd/lineal foot. Shallow soils have limited carrying capacity for conducting water and are in this latter category. Glendon® BioFilter are typically used on sites with shallow soils and therefore it is imperative that designers and installers of this technology be mindful of these concepts and principles.

¹ Tyler, JE and Kuns, LK. 2000. Designing with Soil: Development and Use of a Wastewater Hydraulic Linear and Infiltration Loading Rate Table, Proceedings of the National On-site Wastewater Recycling Association Conference, Grand Rapids, MI. (unnumbered pages between pp. 90 and 91).

² Converse, JC and Tyler, JE. 1998. Soil Dispersal of Highly Pretreated Effluent – Considerations for Incorporation into Code, Proceedings of the National On-site Wastewater Recycling Association Conference, Ft. Mitchell, KY.

- 3.8.2. Normal principles of soil hydraulics must be applied. Examples include:
- Locating the soil absorption area out of swales, concave landscapes, and the toe of slopes.

- Locating the soil absorption area so that the downslope areas are free of physical obstructions, such as building foundations, road cuts, or other Glendon® BioFilter basins.
- The effluent should be spread out along the contour to facilitate conduction of the liquid away from the site.

3.8.3. The reserve area must be sited according to these same principles and be identified and preserved from damage during construction and after the home or facility is occupied.

3.9. Protected Design Elements – The design and installation elements addressed in these standards represent most, but not all, of the critical elements for the two Glendon® BioFilter models.

3.9.1. Glendon® BioFilters are patented and are protected by federal and state statutes regarding trade secrets. Glendon® BioFilter designs and installations must be according to the standards of this document and consistent with the tested and approved models. To this end, local health jurisdictions must have access to the system details protected as trade secrets. These protected critical elements are available to local health jurisdictions in an attachment to a letter from DOH to Environmental Health Directors.

3.9.2. Design Specifics Not Available to The Public Domain / Trade Secrets— The specifics of the following design considerations have been identified as trade secrets and are subject to statutory protection and are the sole property of Glendon® BioFilter Technologies:

3.9.2.1. the filter media, its material descriptions and its arrangement

3.9.2.2. the influent dosing pattern or schedule, and

3.9.2.3. the relationship of unit depth-of-bury to perimeter absorption area.

3.9.3. Glendon® BioFilter must be installed and maintained only by persons certified by the local health jurisdiction to do this work (if required by the jurisdiction). In addition, these persons must also be trained and licensed by Glendon® BioFilter Technologies. Suspension or revocation of certification by the local health jurisdiction will also place the Glendon license in the same status. A list of licensed Glendon personnel is available at the Glendon website (www.glendon.com).

3.10. Monitoring Ports—Monitoring ports, separate from the influent standpipe, may be placed near the rim (Figure 3) to facilitate monitoring of the level of saturation relative to the rim. If monitoring ports are used they should have the following characteristics:

3.10.1. Be anchored to prevent accidental or intentional removal,

3.10.2. Be at least 4 inches in diameter,

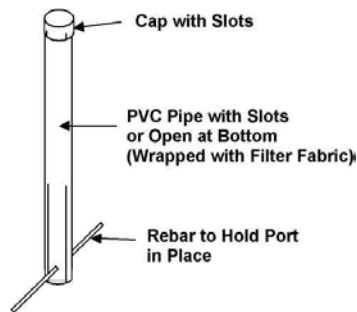
3.10.3. Be inserted to a depth of several inches below the level of the rim of the basin,

3.10.4. Be free of any media,

3.10.5. Be perforated, or be open at the bottom, and the outside wrapped with filter fabric, and

3.10.6. Have the relative vertical distance from the top of the monitoring port to the basin rim recorded on the as-built.

Figure 6 — Monitoring Port



The purpose of the monitoring port and the recorded height of the rim relative to the top of the monitoring port is to provide a means to determine the level of saturation within the basin relative to the rim. This port is useful because observations by some Glendon installers reveal that the height of water in the standpipe does not correspond to the saturation level in the sand at the wall of the vessel.

3.11. Plan Review and Approval — All aspects of the design of Glendon® BioFilters are subject to local health officer review and approval.

3.12. Site Preparation / Protection During Construction —

3.12.1. Both models (M3 & M31) of Glendon® BioFilters rely on the soil surface adjoining the perimeter of the containment vessel to accept and conduct the treated effluent away from the site. To assure that the site is properly prepared prior to, and protected during, construction, the standards for site preparation and protection are included with this document as Appendix A.

3.12.2. Specific details for protecting the site include:

- a prepared and approved construction plan that includes a construction sequence
- proceeding with installation only when soil moisture is low
- proceeding only when seasonally high water tables are not present,
- upslope and downslope soils are adequately protected with temporary sand fill, steel plates or other protective measures
- use of proper tracked equipment
- cautions and precautions in the Glendon Design and Installation Manual are followed
- prefabricated tanks are leveled and bedded with sand or 3/8 inch minus pea gravel.

3.13. Inspection — All aspects of the installation of Glendon® BioFilters are subject to local health officer inspection and approval.

4. Operation and Maintenance —

4.1. The system owner is responsible to assure that routine operation and maintenance of the Glendon® BioFilter is provided in compliance with the manufacturers recommendations, but in all cases at least two times per year. Where the system is required to meet Treatment Standard 1 or 2, the local health jurisdiction may require additional O&M service.

- 4.2. Monitoring and maintenance events and activities are described in the Glendon® BioFilter Technologies Installation Manual, along with recommended service frequencies.

This information is available to local health jurisdictions to assist them in achieving the necessary monitoring and maintenance for the systems.

- 4.3. The authorized representative for Glendon® BioFilter Technologies must instruct or assure that instruction is provided to the owner of the residence or facility regarding proper operation of the entire on-site wastewater system. This instruction should emphasize operating and maintaining the entire on-site wastewater system within the parameter ranges for which it is designed.
- 4.4. Conditions in and around the Glendon® BioFilter must be observed and recorded by the Glendon licensed service provider during all operation and maintenance activities. Those observations must be reported to the local health jurisdiction in a manner that is consistent with the operation and maintenance requirements of the local jurisdiction.

If observations reveal a failure (defined by WAC 246-272-01001) in the BioFilter or the surrounding soil absorption system, the owner of the system must take appropriate action, according to the direction and satisfaction of the local health jurisdiction to alleviate the situation. Any repair or modification activity must be reported as part of the monitoring activity for the site. Appropriate actions may include:

- repairing or replacing the Glendon® BioFilter (Local permits must be obtained before construction begins according to local health jurisdiction requirements for repairs.);
- pertaining to reduced size absorption areas, enlarging the absorption area to initial design size required by WAC 246-272 (Local permits must be obtained before construction begins according to local health jurisdiction requirements.);
- modifying the wastewater strength and/or quantity from the structure served.

4.5. Limited Warranty —

- 4.5.1. Glendon® BioFilter Technologies licensed installers must:

4.5.1.1. warrant all components of the installation to be free from defects in material and workmanship for a minimum of two years from the date of installation, and

4.5.1.2. fulfill the terms of the warranty by repairing or exchanging any components that, in the company's judgment, show evidence of defect.

- 4.6. **Owner's Manual** – The system designer must develop / assemble and provide to the system owner a comprehensive owner's manual. The document must include:

4.6.1. a basic system description;

4.6.2. system owner operation, troubleshooting and maintenance procedures;

4.6.3. the names of and contact information for the designer, installer and initial O&M specialist; and

[Back to Table of Contents](#)

4.6.4. As-built drawings:

- 4.6.4.1.** – all items as per WAC 246-272-14501(3),
- 4.6.4.2.** – exact location of 2 opposite corners of each basin, relative to two permanent fixed objects that are anticipated to be identifiable and accessible over time.
- 4.6.4.3.** – dimensions of the absorption area(s),
- 4.6.4.4.** – locations and dimensions of the reserve area(s) relative to two permanent fixed objects that are anticipated to be identifiable and accessible over time.

[Back to Table of Contents](#)

Appendix A – Site Preparation and Protection During Construction

Site preparation for Glendon® BioFilter

Cut trees to ground level; remove excess vegetation by mowing. Rake the cut vegetation if it is or will become, matted. Prepare the site with the following goals in mind:

- a. To break up the vegetative mat so there is no continuous restriction to the vertical flow of water, to slow the lateral movement of water at the sand-soil interface, and to stabilize the sand at the sand-soil interface.
- b. To avoid compacting the soil with heavy, wheeled equipment (light track mounted equipment should be used for any traffic on the infiltrative surface and on the area 30 feet downslope of the infiltrative surface).
- c. To avoid smearing the soil.
- d. To avoid breaking of the structure of the soil.
- e. To remove excessive vegetation so that it does not form a biomat at the sand-soil interface as it degrades.
- f. To disturb the soil no deeper than necessary. Depth is determined by the thickness of the vegetation and should be no greater than 8 inches. The goal is to loosen the matted layer.


Soil Preparation Process – A spring-loaded agricultural chisel plow is the implement of choice because it is less likely to smear the soil. An implement attached to a backhoe bucket that reaches in is preferred to driving over the basal area. Agricultural cultivators the same shape as a chisel plow are also acceptable implements for soil preparation. Both of these implements are narrow rectangular shapes, which present a diamond shape to the soil. Cutting the soil with backhoe teeth is not acceptable, but chisel plows and other agricultural implements described above can be mounted on the leading edge of the bucket using a bar on the outside with the teeth attached to the bar. Alternatively, they can be mounted on a wheeled implement that is dragged across the slope where the infiltrative area is planned. Hand-spading the surface is also an acceptable alternative and may be the preferred method on some sites. Rototilling is not an acceptable substitute and must not be used.

Soil Moisture Content – The important point is that a rough, unsmeared surface should be left, especially in fine textured soils. Careful observation is required to assure that the soil moisture content is not too high so that the soil surface is not smeared by the action of the soil preparation process. Preparation should not proceed while the soil moisture content is too high. The finer textured soils should not be too dry, either, as the preparation process will pulverize it, destroying the structure.

Immediate construction after soil preparation is desirable. Avoid rutting and compaction of the prepared area by traffic. If it rains after the soil preparation is completed, wait until the soil dries out before continuing construction.

Appendix B – Glendon Data Plate

Glendon® BioFilter Technologies, Inc.
25448 Port Gamble Road NE · Poulsbo, WA 98370
www.glendon.com



For service call _____

Model # _____ Design Daily Cap. (US Gal.) _____

Serial # _____ Software Ver. _____

Patented US Patents 4,997,568; 5,281,332; and 5,632,896
Canada Patents 2,065,350 and 2,073,969 Japan Patent 3,068,645

Appendix C -- Glossary of Terms

Term	Meaning / Description
Alternative System	An on-site sewage system other than a conventional gravity system or conventional pressure distribution system. Properly monitored and maintained alternative systems provide equivalent or enhanced treatment performance as compared to conventional gravity systems.
Biochemical Oxygen Demand (BOD₅)	A test which measures the molecular oxygen used by microorganisms during a five day incubation period at a temperature of 20 ⁰ C (68 ⁰ F) for the biochemical degradation of organic material (CARBONACEOUS DEMAND), and the oxygen used by microorganisms to oxidize inorganic material such as sulfides and ferrous iron. It also may measure the amount of oxygen used to oxidize reduced forms of nitrogen such as ammonia and organic nitrogen (NITROGENOUS DEMAND) if the microorganisms capable of mediating the reaction are present in the sample.
Carbonaceous Biochemical Oxygen Demand (CBOD₅)	Same as the 5-day biochemical oxygen demand (BOD ₅) test, except that the NITROGENOUS DEMAND is <u>prevented</u> by addition of an inhibitory chemical to the sample.
Coliform (Bacteria)	A group of bacteria that produce gas and ferment lactose, some of which are found in the intestinal tract of warm-blooded animals. They are indicators of potential ground water and/or surface water contamination with such fecal material. The coliform group of organisms includes all of the aerobic and facultative anaerobic, gram-negative, non-spore-forming, rod-shaped bacteria that ferment lactose with gas formation within 48 hours at 35 ^o C.
Disposal Component	A subsurface absorption system (SSAS) or other soil absorption system receiving effluent from a septic tank or other pretreatment device and transmitting it into original, undisturbed soil.
Dosing Tank / Chamber	A tank which collects treated effluent and periodically discharges it into another treatment / disposal component, depending upon the needs and design of the particular on-site sewage system.
Drain Rock	Clean, washed gravel, varying in size from ¾ inch to 2 ½ inches.
Effluent	Liquid which is discharged from an on-site sewage system component, such as a septic tank (septic tank effluent) or sand filter (sand filter effluent).
Fecal Coliform (Bacteria)	Coliform bacteria specifically originating from the intestines of warm-blooded animals, used as a potential indicator of ground water and/or surface water pollution.
Filter Media	The material through which wastewater is passed for the purpose of treatment.
Infiltrative Surface	In drainfields, the drain rock-original soil interface at the bottom of the trench; in mound systems, the gravel-mound sand and the sand-original soil interfaces; in sand-lined trenches/beds (sand filter), the gravel-sand interface and the sand-original soil interface at the bottom of the trench or bed.
Influent	Wastewater, partially or completely treated, or in its natural state (raw wastewater), flowing into a reservoir, tank, treatment unit, or disposal unit.
Linear Loading Rate	The loading rate of wastewater per linear foot of infiltrative system into the native soil (gallons per day per linear foot along the contour).
Mound (Sand Mound)	A treatment and disposal component that is built with a specific sand media and is placed upon the ground surface.
On-Site Sewage System	An integrated arrangement of components for a residence, building, industrial establishment or other places not connected to a public sewer system which: (a) Convey, store, treat, and/or provide subsurface soil treatment and disposal on the property where it originates, upon adjacent or nearby property; and (b) Includes piping, treatment devices, other accessories, and soil underlying the disposal component of the initial and reserve areas.
Proprietary Device Or Method	A device or method classified as an alternative system, or a component thereof, held under a patent, trademark or copyright.
Pump Chamber	A tank or compartment following the septic tank or other pretreatment process which contains a pump, floats and volume for storage of effluent. In timer-controlled pressure distribution systems, this is frequently called a "surge tank" or "equalization tank." If a siphon is used, in lieu of a pump, this is called a "siphon chamber."
Residential Sewage	Sewage having the consistency and strength typical of wastewater from domestic households.
Restrictive Layer	A stratum impeding the vertical movement of water, air, and growth of plant roots, such as hardpan, clay pan, fragipan, caliche, some compacted soils, bedrock and unstructured clay soils.
Septic Tank	A water tight pretreatment receptacle receiving the discharge of sewage from a building sewer or sewers, designed and constructed to permit separation of settleable and floating solids from the liquid, detention and anaerobic/facultative digestion of the organic matter, prior to discharge of the liquid.
Sewage	Any urine, feces, and the water carrying human wastes including kitchen, bath, and laundry wastes from residences, building, industrial establishments or other places. For the purposes of this document,

Term	Meaning / Description
	"sewage" is generally synonymous with domestic wastewater. Also see "residential sewage."
Soil Type 1A	Very gravelly coarse sands or coarser, extremely gravelly soils.
Subsurface Soil Absorption System - "SSAS"	A system of trenches three feet or less in width, or beds between three feet and ten feet in width, containing distribution pipe within a layer of clean gravel designed and installed in original, undisturbed soil for the purpose of receiving effluent and transmitting it into the soil.
Suitable Soil	Original, undisturbed soil of types 1B through 6.
Timer-Controlled System	A pressure distribution system where the pump on and off times are preset, discrete time periods.
Total Suspended Solids (TSS)	Suspended solids refer to the dispersed particulate matter in a wastewater sample that may be retained by a filter medium. Suspended solids may include both settleable and unsetttable solids of both inorganic and organic origin. This parameter is widely used to monitor the performance of the various stages of wastewater treatment, often used in conjunction with BOD ₅ to describe wastewater strength. The test consists of filtering a known volume of sample through a weighed filter membrane that is then dried and re-weighed.
Treatment Standard 1	A thirty-day average of less than 10 mg/l of BOD ₅ and 10 mg/l of total suspended solids and a thirty-day geometric mean of less than 200 fecal coliform/100ml.
Treatment Standard 2	A thirty-day average of less than 10 mg/l of BOD ₅ and 10 mg/l of total suspended solids and a thirty-day geometric mean of less than 800 fecal coliform/100ml.
Vertical Separation	The depth of unsaturated, original, undisturbed soil of Soil types 1B - 6 between the bottom of a disposal component and the highest seasonal water table, a restrictive layer, or Soil Type 1A.
Washington Administrative Code	Specific rules developed to carry out the broad intent of the laws passed by the legislature and governor.
Wastewater	Water-carried human excreta and/or domestic waste from residences, buildings, industrial establishments or other facilities. (See sewage.)
Wastewater Design Flow	The volume of wastewater predicted to be generated by occupants of a structure. For residential dwellings, this volume is calculated by multiplying the number of bedrooms by the estimated number of gallons per day (gpd), using either the minimum state design standard (120 gpd) or the locally established minimum standard (such as 150 gpd).
Wastewater Treatment Unit	A unit designed, constructed, and installed to stabilize liquid waste by biochemical and physical action.